Analysing the Determinants of Terrorism in Turkey using Geographically Weighted Regression

JÜLIDE YILDIRIM[a*], NADIR ÖCAL[b] and NEBILE KORUCU[c]

[a] Department of Econometrics, Gazi University, Ankara, Turkey; [b]Department of Economics, Middle East Technical University, Ankara, Turkey; [c]Istanbul Kültür University, Department of Economics, Istanbul-Turkey.

Total Word: 7294

[*] Corresponding author. Department of Econometrics, Gazi University, 06500, Ankara, Turkey. E-mail address: julide@gazi.edu.tr. Phone: +90 312 216 1301. Fax: +90 312 213 2036.

Analysing the Determinants of Terrorism in Turkey using Geographically Weighted Regression

Turkey has been one of the hardest hit countries by terrorist incidents for nearly four decades. There are few studies assessing the economic impacts of terrorism both at regional and provincial level for Turkey. However the root causes of terrorism have yet to be examined. The major characteristic of the terrorist incidents in Turkey is its geographical dimension in that the average terrorist incidents and particularly average fatalities are mainly concentrated in the Eastern, South Eastern Turkey and the major cities. This study is an attempt to investigate the determinants of provincial terrorism taking spatial dimension into account for the time period 1990-2006. Following a traditional global regression analysis, spatial variations in the relationships are examined with geographically weighted regression (GWR) to obtain locally different parameter estimates. Preliminary empirical results indicate that increases in income and schooling ratio tend to reduce the provincial average level of terrorism, whereas an increase in unemployment enhances it. Moreover GWR results indicate that the provincial effects of per capita income and education are more pronounced for the Eastern and South Eastern provinces compared to the Western provinces.

Keywords: Terrorism, geographically weighted regression, Turkey.

Turkey has been fighting against terrorism and political violence for nearly four decades. There have been attacks mainly to civil service institutions; schools; tourists and touristic sites; transportation and telecommunication service facilities; business enterprises and

mostly army bases that have cost almost 40000 lives. Active terrorist groups include the Turkish Hizballah, the Kurdish separatist group known as the Kurdistan Freedom and Democracy Congress (PKK) the Revolutionary People's Liberation Party/Front (DHKP/C), as well as other entities tied to terrorist groups based in neighbouring countries. Previous empirical evidence provided by Ocal and Yildirim (2010) indicate that terrorism hinders economic growth in Turkey and its negative effects are more pronounced in the terror stricken South Eastern Turkey. Feridun and Sezgin (2008), on the other hand, examine the possible role of the regional underdevelopment of South Eastern provinces of Turkey in the ensuing terrorism in the country. They report that agriculture and government services are more important components of GDP in explaining terrorism compared to other factors, such as trade, construction, manufacturing and transportation. Thus they suggest that counter-strategies to reduce terrorism in Turkey should consider the significant role of underdevelopment of the South Eastern provinces.

Even though the effects of terrorism on various sectors and the overall economy have been assessed in the literature, they cannot capture the total impact of terrorism as it entails important social and political costs that are difficult to estimate, such as the intangible costs of violence, insecurity and human suffering. Empirical studies investigating the economic impact of terrorist incidents generally report that terrorist activities affect economic growth through various channels: It may lead to an increase in military expenditures (Eckstein and Tsiddon, 2004); an increase in production and transaction costs (Frey et al. 2007); a decrease in tourism revenues (Enders et al. 1992; Yechiam et al. 2005); a decrease in savings (Fielding 2003) and a decrease in foreign direct investment (Fielding 2004). Thus it is important to reveal the determinants of terrorism in order to be able to draft counter-terrorist measures.

Existing studies trying to investigate the determinants of terrorism agree that terror can originate more easily in economically and politically under-developed countries and / or

provinces. Krieger and Meierriecks (2008) report that while liberal political institutions, economic integration and peaceful aspects of international politics likely to reduce transnational terrorism, population size, aggressive and strategic international factors, and spatial and temporal contagion foster terror production. Even though international factors do not matter for domestic terrorism, economic, institutional and demographic factors are among the important determinants of terrorism dynamics. The bulk of empirical studies trying to reveal the root causes of terrorism employs cross country data, mainly focusing on transnational terrorism, recognizing its dyadic nature with respect to the sources and targets of transnational terrorism (Blomberg and Rosendorff, 2006; Blomberg and Hess, 2008a; Azam and Delacroix, 2006; Lai, 2007; and Azam and Thelen, 2008; Piazza, 2008). Moreover country specific studies, using micro level data, try to investigate the country- or region-dependent terrorism dynamics (Krueger and Maleckova, 2003; Berrebi, 2007 and Feridun and Sezgin, 2008).

Empirical studies investigating the root causes of terrorist incidents generally employ traditional cross sectional analysis, implicitly assuming the same economic, social and political environments for countries under consideration. This is a highly restrictive assumption and may result in heterogeneity bias. Resorting to country studies rather than cross-country analysis may overcome such a heterogeneity bias. Another issue, which is often neglected by the existing literature, is the geographical dimension of terrorism. Only few studies mention that geographical factors play an important role in determining the likelihood of terrorist incidents[1]. The relationships between the incidents of terrorism and various factors are generally assumed to be stationary in space and a single regression equation has been employed in empirical studies, which produces an average or global relationship that might not be valid over the entire study area, as the variation in parameters can lead to inconsistent estimators (Temple 1999).

[1] See for example Abadie (2004), Barros and Proenca (2005) and Llussa and Tavares (2007), among others.

However it is reasonable to assume that the relationships between the level of terrorism and various factors are different in different areas of countries /provinces necessitating unique local regression parameters representing the relationship. Locally different parameters can be calculated by the technique of geographically weighted regression (GWR) developed by Brunsdon et al. (1998) and Fotheringham et al. (1998, 2002). It allows different relationships to exist at different points in space (Fotheringham et al. 1997; Leung et al. 2000), and estimates local rather than global parameters.

This study aims to contribute to existing literature by investigating the determinants of terrorism dynamics in Turkey employing provincial level data. The main contribution of this study is twofold: The first is that this study is a regional effect analysis employing provincial level annual data, relating to 67 provinces of Turkey[2], rather than a cross-country analysis. Secondly in addition to the global parameter estimates, local parameter estimates are also obtained, taking into account the heterogeneity bias associated with the traditional cross-section analysis. First the relationship between terrorism and economic and demographic factors has been examined employing traditional cross-section analysis. Then this model is extended to capture the spatial aspects of the issue, where the root causes of terrorism is examined in a GWR modelling framework for the time period 1990-2006. The model selection criterion (AIC) indicates the selection of the GWR model, which provides a statistically significant improvement over the OLS model, indicating that the typical least-squares model is misspecified. Moreover, the GWR estimation results indicate that there are considerable variations in the parameter estimates, especially in that of per capita income. Empirical results suggest that provincial per capita income and education hinder terrorism in Turkey, whereas

[2] From 1990 onwards the number of provinces has been increased from 67 to 81. But the original 67 provinces have been included in our analysis, as the data relating to new provinces do not cover the time period under consideration.

increases in unemployment foster it. Moreover the effects of per capita income and education are more pronounced in the relatively less developed South Eastern provinces compared to the more developed Western provinces. The rest of the paper is organized as follows: Section 2 briefly reviews existing literature. Section 3 gives a brief account of the nature of terrorism in Turkey. The model and empirical results are summarized in Section 4. Finally Section 5 concludes.

Literature Review

Enders and Sandler (1993, 1999 and 2000) define terrorism as the premeditated use or threat to use violence by individuals or subnational groups against noncombatants to obtain political and social objectives through the intimidation of a large audience beyond that of immediate victims. The essential ingredients of terrorism, then, are violence and ideological, social and political motive. Generally terrorist acts appear to be random and disperse in order to cause tension to the widest possible audience and to create a general atmosphere of fear so that government officials can be forced to reach an accommodation with the terrorists. Even though the effects of terrorism on various sectors and the overall economy have been assessed in the literature, the total impact of terrorism cannot be captured as it entails important social and political costs that are difficult to estimate.

Generally existing literature agrees that terrorism is expected to hinder economic growth through various channels, such as increase in productions and transaction costs, decrease in tourism revenues, decrease in foreign direct investments and international trade. Blomberg et al. (2004a) report that terrorism leads to a diversion of spending from investment to government expenditures. Additionally, Abadie and Gardeazabal (2008) introduce terrorism as catastrophic risk in a standard endogenous growth model and report that an increase in the intensity of terrorism leads to a fall in net foreign investment positions. Abadie and

Gardeazabal (2003) report a 10% decline in per capita GDP in the Basque region of Spain, relative to a synthetic control region, caused by the outbreak of terrorism in the 1970s. Eckstein and Tsiddon (2004), on the other hand, investigate the effects of terrorism on the macroeconomy of Israel. Their analysis indicates that terrorism's impact on exports and investment is three times larger than on nondurable consumption and two times larger than on GDP. Fielding (2003) reports that greater political instability and violence lead to lower savings and higher current consumption in Israel for the time period 1988-1999. Whereas Fielding (2004) argues that an increase in conflict intensity leads to substantial capital flight. Furthermore capital flight in the current quarter leads to increased conflict intensity in subsequent quarters. Eldor and Melnick (2004), using daily data from the Israeli markets, report that suicide attacks have a permanent effect on both the stock and foreign exchange markets. Although the number of victims has a similar effect, the location of a terror attack has no effect on either market.

Additionally, another strand of the literature investigates the sector specific effects of terrorism. Hall and O'Sullivan (1996) claim that any kind of political instability or terrorist act that may hinder the safety of the visitor will lead the tourists to alter their travel behavior leading to a decrease in the tourism revenues of host countries. Neumayer (2004) provides empirical evidence suggesting that conflict and politically motivated violent events negatively affect tourist arrivals with intraregional, negative spillover and cross-regional substitution effects. Since there may be interdependencies between different countries' tourism revenues and terrorist incidents, the effect of terrorism on tourism is likely to spill over into other countries (Drakos and Kutan, 2003). Further evidence provided by Nitsch and Schumacher (2004) and Blomberg and Hess (2006) suggest that countries targeted by terrorism trade significantly less with each other than countries not affected by terrorism. Moreover, terrorists can attack and destroy foreign owned firms which may affect the allocation decision of firms investing money

in real foreign assets. Thus a terror-stricken country may lose inflow of foreign capital as foreign investors may invest in other countries that have not been affected by terrorism (Enders and Sandler, 1996).

Existing literature documents the channel through which terrorism hinders economic growth. In order to design policy measures to prevent the negative effect of terrorism on various sectors of economic activity, it is important to investigate the root causes of terrorism. The literature on terrorism regard terrorists as rational actors who maximize their utilities, given certain benefits, costs and constraints that are linked to terrorist actions (Sandler and Enders, 2004; Caplan, 2006). Empirical literature investigates certain country specific factors, such as economic, political, demographic, geographic and international features, that impact terrorists' cost – benefit matrices and hence their behaviour. Among other factors, economic deprivation has been argued to be one of the major determinants of violent behaviour (Gurr, 1970; Blomberg et al. 2004b). Even though the argument that poverty creates terrorism has been investigated extensively (among others for example Abadie, 2004; Piazza 2006; Li, 2005 and Bravo and Dias, 2006), these studies cannot reach an agreement concerning the the existence and the direction of a clear association between economic variables and the terrorist incidents. Lai (2007) and Blomberg and Hess (2008b) claim that structural economic conditions such as high income and income equality hinder terrorism. Whereas Krueger and Malečková (2003) and Kurrild-Klitgaard et al. (2006) fail to find any significant connection between economic conditions and terrorism. Feridun and Sezgin (2008), on the other hand, suggest that economic factors are important for explaining terrorism in South Eastern Turkey.

A number of empirical studies conclude that political variables, such as the level of democracy and the extent of civil liberties are far more important than socio-economic variables such as poverty, inequality and education. Krueger and Maleckova (2003) find little correlation between economic factors, such as GDP per capita or GDP growth, and the incidence of terrorism studies. Abadie (2004) reports that terrorism risk in a country is not affected by its

income per capita, but political rights have a non-monotonic relationship with terrorism risk. Blomberg et al. (2004b) using a Markov process, reveal that economic activity and terrorism are not independent of one another, in that high income and democratic countries appear to have a higher incidence of terrorism, and a lower incidence of economic contractions. Moreover terrorist incidents appear to be associated with the economic business cycle: periods of economic weakness increase the likelihood of terrorist activities. Blomberg and Hess (2008a) report that development, democracy and openness are each positive influences in creating a more peaceful environment for countries that are a source of terrorism. But they also note that these same factors make a country more likely to be a target for terrorism. Blomberg and Rosendorff (2006) claim that the advent of democratic institutions does significantly reduce the likelihood of citizens from one country engaging in terrorist activities against another country.

Empirical studies examining the effects of changes in relative and absolute economic positions over time tend to find variables that measure deprivation to be statistically significant in explaining the number of incidents. Li and Schaub (2004) report that there is a direct link between economic suffering and support for political violence. Their analysis suggest that economic development discourages terrorism. Moreover Li (2005) reports that democracy can reduce terrorism. Empirical studies investigating the role of the government in fight agains terrorism suggest that welfare policies and increased government expenditure significantly discourage terrorist activity (Burgoon, 2006; Freytag et al., 2008). Furthermore the composition and capacity of governments are also important in determining terrorism, such that in countries led by more leftist or capable governments, the terrorism production increases. Burgoon (2006) claims that more generous welfare spending relative to GDP tends to reduce terrorism occurring in a cross-section of countries and in a panel of countries over time, by

reducing economic insecurity, religious-political extremism, income inequality, and poverty—thereby offsetting welfare's possible tendency to increase capacities to organize terror.

The effects of various demographic factors on terrorism are also considered by the existing literature. Several studies support the hypothesis that more populous countries are more likely to produce terrorism (Krueger and Maleckova,2003; Burgoon, 2006; Lai, 2007; Plümper and Neumayer, 2007; Freytag et al., 2008; Piazza, 2008). However evidence regarding the the effect of education on terrorism is very diverse. Although Azam and Thelen (2008) and Krueger and Maleckova (2003) provide evidence suggesting that higher educational levels discourage terrorism production, Kurrild-Klitgaard et al. (2006) claim that higher levels of education even tend to encourage terrorism. Whereas Freytag et al. (2008) report that the human capital levels have a significant effect on terrorism, but it varies with different spatial scopes. Bravo and Dias' (2006) cross-country analysis reveal that terrorist incidents tend to occur in less-developed countries, with non-democratic regimes, low literacy levels and less dependence on international trade.

The spatial dispersion of the data on terrorism has also been taken into account in studies investigating the nature and the economic consequences of terrorist incidents. The geopolitical factors such as the geographic position, the political regime, large mineral resources, energy and food reserves are relevant determinants of terrorism. Moreover the empirical results are better for smaller and less heterogeneous samples indicating spatiality inherent in the terrorist incidents. The geographic factors may be important to sustain terrorism. The failure to eradicate terrorism in some areas of the world has often been attributed to geographic barriers, like mountainous terrain or tropical jungle, such areas of difficult access offer safe haven to terrorist groups, facilitate training, and provide funding through other illegal activities. Since geographic factors affect economic development, it is potentially important to correct for the confounding effect of these variables (Abadie, 2004). Bravo and Dias (2006) report that there

has been a change in the geographic distribution of the number of terrorist incidents, with a greater concentration in the Eurasian continent relative to the two previous decades, particularly in the Middle East and in the South East. Li and Schaub (2004) compare the number of terrorist incidents in Europe, Africa, Asia, and America, relative to a reference region—the Middle East. Their findings indicate that the Middle East has the highest concentration of transnational terrorist incidents, with Europe ranked second. Enders and Sandler (2006) report that the post 9/11 period has witnessed a significant transference of terrorist incidents from North America and West Europe to the Middle East and Asia. Moreover Blomberg and Rosendorff (2006) and Blomberg and Hess (2008a) find that distance between two countries discourages transnational terrorism significantly. Lai (2007) claims that proximity to other countries suffering from terrorism increases the likelihood of production of terrorism on own soil substantially. Braithwaite and Li (2007) report that countries with significant experiences with terrorist incidents are often located close to each other. Besides when a country is located within a terrorism hot-spot neighborhood, it is highly likely to experience a large increase in its number of terrorist attacks in the next period.

Terrorist Events in Turkey

Turkey has been fighting against terrorist activities at both national and international levels, over three decades. Terrorist activities in Turkey had a high cost in terms of human lives and material resources, with some 40,000 lives lost, many people maimed for life and more than $100 billion of resources spent in the effort. In addition to immediate effects of lost lives and property, its side effects have been equally dreadful. Turkish troops have been suffering casualties almost daily from mines, roadside bombs and even ambushes mainly in the South Eastern part of Turkey. Terrorists burned down schools and health centers, killed and intimidated public servants -- including more than 100 elementary school teachers murdered

before the eyes of their students -- to prevent them from delivering services (Loğoglu, 2008). People affected by terrorist incidents have been forced to leave their homes and migrate to other locations. During the long fight against terrorism, various terrorist organizations have adapted their objectives to domestic and international circumstances, changing their strategies and tactics -- even their names. The roots of terrorism in Turkey stretches back to 1960s and 1970s, two decades marked by tremendous political and social upheaval in Turkey. Rodoplu et al. (2003) claim that several factors contribute to the instability of this period, such as rapid urbanization as the population migrated from rural Turkey to main cities; economic hardships as employment failed to keep up with an exploding urban population; growing unrest in the South Eastern provinces; and nascent radical Islamic and leftist student movements.

Terrorist activities in Turkey can be classified into four major episodes[3]. The first one was the ideology related left-wing and right-wing conflicts that had started in the late 1960s giving rise to numerous domestic terrorist organizations. The second episode of terrorism has been the radical religious terrorism aiming to replace the democratic and secular regime with an Islamic regime. The third and the most brutal flow of terrorism is the separatist and ethnic terrorism, the main goal of which has been the establishment of an independent state in the region that now is part of South Eastern Turkey, Northern Syria and Iraq and Western Iran. It is responsible for the vast majority of terrorism-related casualties in Turkey, especially in the South Eastern provinces, during the past two decades, while establishing a profitable economic base in drug-trafficking. By the 1990s, the ethnic terrorism had spread to a variety of urban targets within Turkey and at least six other countries in Western Europe. The final episode of terrorism is the global one created by radical religious terrorist organizations. It differs from the other terrorist organizations in terms of its goals and organization.

[3] For a detailed account of terrorist activities in Turkey please see Öcal and Yıldırım (2010).

INSERT FIGURES 1-4 HERE

The major characteristic of the terrorist incidents in Turkey is its geographical dimension. Figures 1 to 3 show the average numbers of terrorist incidents, fatalities and injuries for the time period 1990-2006, respectively. Figure 4, on the other hand, presents the distribution of the terrorism index for Turkish provinces.[4] It appears from these figures that average terrorist incidents and particularly average fatalities are mainly concentrated in the Eastern, South Eastern Turkey and the major cities. There have been 128 attacks against schools or teachers between 1984 and 2000. Moreover numerous attacks on other public and commercial infrastructure, such as bridges, dispensaries, electricity plants, oil facilities and pipelines, in the South East Anatolia have been carried out to deter investment in the region.

Memorial Institute for the Prevention of Terrorism (MIPT) database figures indicate that the vast majority of terrorist attacks in Turkey to date have produced less than 10 victims. Between 1990 and 2006 there had been 1051 terrorist incidents in Turkey. The average number of fatalities and injuries per terrorist event were 0.73 and 2.76, respectively. The majority of terrorist incidents reported in Turkey since 1990 have been bombings, accounting 72 percent of all incidents. It is followed by armed attacks which constitutes 10 percent of all terrorist incidents in that period. Arson and kidnapping are the least resorted type of action with a share of only 3 percent in total incidents. The main target of terrorist activities in Turkey during 1990-2006 was the business enterprises totaling 245 incidents. They have been carried out in the major industrial cities such as Ankara, İstanbul, İzmir and Adana. Whereas terrorist attacks against utilities, government offices and officials, that have accounted for 20 per cent of all incidents, have been performed mainly in the Eastern and South Eastern provinces. Rodoplu et

[4] Terrorism index is calculated as the averages of incidents, injuries and fatalities occurred in province i at time t. Data relating to the terrorist incidents are obtained from Memorial Institute for the Prevention of Terrorism (MIPT) databases of international terrorism incidents.

al. (2003) and Öcal and Yildirim (2010) report that the major characteristic of terrorism in Turkey during the past two decades is that it disproportionately affected the Eastern and South Eastern provinces of Turkey. The PKK attacked many schools, government offices, business enterprises and religious buildings in these provinces. The PKK also targeted government officials, killing eight mayors, 116 teachers and 27 religious officials. The main aim of these incidents were to severe the relation of residents with administrative or public service officials so that the South Eastern Anatolia would be isolated from the rest of Turkey and to derive investors out of Eastern and South Eastern provinces.

Model and the Empirical Results

This study tries to investigate the possible economic and demographic causes of terrorism employing provincial level data for Turkey. A multivariate model was developed to estimate average levels of terror in provinces of Turkey during the 1990 to 2006 period. To this end the terrorism index (T) is defined as the averages of terrorist incidents, injuries and fatalities for each province i at time t, following Eckstein and Tsiddon (2004). The explanatory variables included in the analysis are provincial level real per capita GDP (Y), schooling ratio (E), provincial total unemployment (U) and a dummy variable which takes the value of 1 if the province is a coastal province (Coastal).[5] Data relating to the terrorist incidents are obtained from Memorial Institute for the Prevention of Terrorism (MIPT) databases of international terrorism incidents. All other variables are obtained from Turkish Statistical Institute and all monetary variables are real at 1990 prices. Each variable is averaged over 1990-2006.

[5] Even though additional variables such as population, real government expenditures and additional characteristics of the provinces, such as if the province is included in the development programmes or located in the South Eastern Turkey are also considered, these variables found to be statistically insignificant. Therefore they are excluded from the analysis.

Since terrorist incidences in Turkey are localized mainly in South Eastern provinces as well as the main cities, it is reasonable to expect differential impacts from terrorism on economic variables. The hardest hit provinces are expected to suffer more in terms of lost economic activity, trade, investment and tourism revenues. Evidence provided by Ocal and Yildirim (2010) support this hypothesis. In the same way, it would be unrealistic to assume that there are average or global determinants of terrorism in Turkey. The local determinants of provincial terrorism in Turkey can be examined by the calculation of locally different parameters, which can account for the heterogeneity bias inherent in the traditional cross-section analysis, as the variation in parameters can lead to inconsistent estimators (Temple 1999). Locally different parameters can be calculated by the technique of geographically weighted regression (GWR). This approach can directly assess error residuals using measured and predicted values. Moreover it can calculate residuals for locations where there is no measured data and provides confidence information using the goodness of fit statistic. GWR produces local parameter values for each region/province in the data set rather than simply estimating global coefficient values over the whole data set. In each province's individual regression, other provinces in the sample are weighted by their spatial proximity. Thus, the spatial variation in parameters is smoothed by spatial weighting, revealing broad regional differences in the parameters.

When compared with the standard approaches, the GWR analysis has some advantages. One of the main advantages is that it accounts for province fixed effects as each province has its own constant term. Moreover, any outlier estimates that may occur are offset because the GWR approach produces literally thousands of regressions, examining the median and the entire range of estimates. Additionally Fotheringham et al. (2002) note that the GWR approach can greatly reduce spatial error correlation when there is heterogeneity in the GWR coefficients. In other words, as global OLS regressions estimate one fixed global set of regression coefficients, there may be spatially clustered groups of provinces/ regions with either over or

underestimated residuals. In global OLS regressions it may not be possible to distinguish the ensuing spatial correlation caused by the underlying heterogeneity in the regression coefficients from standard spatial error correlation that is generated by shocks originating in one region impacting others. However, the GWR approach directly corrects for the underlying spatial heterogeneity.[6]

Accordingly, the following model is estimated by both traditional global, OLS, and local, GWR, estimation methods:

$$T_i = \alpha + \delta \log Y_i + \lambda \log U_i + \phi E_i + \eta coastal_i + v_i$$

Table 1 presents the descriptive statistics of the parameter estimates from OLS and GWR models of the presented in equation (1). In Table 1 R^2 denotes the coefficient of determination and AIC denotes Akaike Information criterion. All variables have the expected signs and are statistically significant. The global model OLS estimates, presented in Table 1, indicate that increases in per capita real income and schooling ratio hinder terrorism, whereas increases in unemployment fosters it. Moreover coastal dummy variable has a positive effect on terrorism, which could be due to the fact that developed cities like Istanbul, Izmir, Antalya and Mugla that also happen to be major tourist cites, have ports. These cities happen to be targets of terrorist incidents. The model selection criterion (AIC) indicates the selection of the GWR model. Additionally, the F statistics reported at the bottom of the Table 1 indicates the rejection of the null hypothesis (P-value 0.00 for the partial F-test) suggesting that GWR model significantly improves model fitting over the OLS model.

The spatial distribution of parameters of the local model are presented in Figures 5-7. There appears to be significant variations in the spatial distribution of the coefficients of per capita real income (Figure 5) and education (Figure 6). Empirical analysis suggests that increases in

[6] Please see Fotheringham et al. (2002) and Ocal and Yildirim (2010) for a detailed account of GWR methodology.

average levels of per capita income and education variables contribute to the reduction of terrorism more in the comparatively less developed Eastern provinces. Whereas the effects of real per capita income and education are lesser in Western provinces. These are reflected by the negative and significant effects in the global models and negative median GWR coefficients. Yildirim et al. (2009) provide evidence that structural differences between the provinces are sustained in that Western provinces are comparatively more developed than the Eastern provinces of Turkey. In the less fortunate Eastern provinces real per capita income and education levels are lower than those of Western provinces. Hence any improvement in the economic wellbeing as well as in human capital appears to have a comparatively higher effect on terrorism in these provinces compared to the wealthy Western provinces. Moreover rich cities such as İstanbul, İzmir, Mugla and Antalya, which are also major tourist destinations are located in Western Turkey. These cities are also major targets for terrorist activities. Accordingly an increase in per capita income would probably increase the chances that these cities will be targets of new terrorist incidents. Because, the aim of the terrorist activities is to inflict as much damage as possible to factories, tourist destinations and government officies including schools. Additionally the level of education and employment are higher in Western provinces compared to the less developed Eastern provinces, suggesting that residents in Western provinces are already conscious about the effects of terrorism and they would not want to lose their jobs because of it. The average level of education in Eastern Turkey is already low since the children are usually employed in the family's agricultural activities. Moreover girls are generally not educated because traditionally it is believed that there is no value added gained by educating the girls as they are married off early and leave the maternal home. These arguments therefore lend support to the spatial distribution of average per capita GDP and education variables.

Empirical analysis indicates that an increase in the average level of unemployment fosters terrorism especially in the Western provinces, whereas it has comparatively lesser effect in South East and East Anatolia (Figure 7). The harsh weather conditions, lack of arable land in the Eastern and South Eastern provinces of Turkey, which are the most poverty stricken provinces of Turkey, limit the production possibilities for agriculture and industrial sectors. Thus, coupled with high fertility rates, these provinces already have lower levels of GDP per capita and employment opportunities compared to the Western provinces. However employment opportunities are much higher in the Western provinces, especially in North Western cities where industrial and agricultural productions are concentrated. Thus any increase in unemployment levels is expected to effect Western provinces severely compared to the Eastern provinces. This is also reflected in the contribution of unemployment to terrorism for the time period under consideration.

Moreover, since the GWR model takes the spatial dimension into account it produces a better fit for the model. The R^2 of the GWR model is greater than that of the global model.. Overall, empirical analysis indicates that provincial average terrorism has become geographically more concentrated for the time period under consideration. It appears that the effects of average levels of income and education on terrorism are more pronounced in the terror and poverty stricken Eastern provinces. Whereas opposite holds regarding average provincial unemployment levels.

Conclusion

Even though there exists studies investigating the root causes of terrorism employing cross-country data, there is a paucity of empirical evidence regarding the determinants of terrorism employing provincial level data. Moreover, previous research generally assumes the same economic, social and political environments for countries under consideration. However, this

highly restrictive assumption may result in heterogeneity bias. The infrastructure, economic, political and social conditions as well as the behavior and attitudes of people vary across regions and provinces, leading to locally different parameters. However the global estimation techniques ignore this heterogeneity, leading to a bias and provoke autocorrelation. One way to overcome these problems is to resort to country studies rather than cross-country analysis and investigate the issue by employing the geographically weighted regression which produces local parameter estimates rather than global ones.

In order to overcome the problems associated with the cross-country studies, this study investigates the possible root causes of terrorism for Turkey employing provincial level annual data for the time period 1990-2006, employing local and global estimation methods. Traditional cross-sectional analysis suggests that average levels of real per capita income and education hinders terrorism, whereas the average level of unemployment fosters it. Moreover, empirical evidence indicates that GWR model significantly improves model fitting over the traditional global model, indicating that the traditional global model is misspecified. Besides GWR model estimates reveal that there are considerable variations in the parameter estimates. The favourable effects of average real per capita income and average level of education are greater in less developed Eastern provinces. However the adverse effects of unemployment on terrorism are more pronounced in the Western provinces, compared to the Eastern provinces where most of the terrorist activity has been concentrated.

Persistent disparities in aggregate growth and large differences in the wealth of the Eastern and Western regions have long been among the main concern of policymakers in Turkey. Priority Provinces for Development (PPDs) were defined and all provinces of Eastern and South Eastern Anatolia were given priority in public investment in an attempt to accelerate the process of convergence and to reduce interregional disparities. However these measures have not been able to reduce the income inequality between the Eastern and Western provinces of

Turkey. Ocal and Yildirim (2010) argue that this dichotomy is also reflected in the economic growth effects of terrorism, in that negative effects of terrorism on economic growth are more prominent in the South Eastern provinces compared to the Eastern and Western provinces of Turkey. Empirical evidence provided by this article indicates that East-West dichotomy is prevalent regarding the root causes of terrorism. Our findings suggest that the government should revise its policies for reducing interregional disparities. Any attempt to enhance economic growth and increase education levels and employment will hinder terrorism.

Figure 1
The Spatial Distribution of Average Terrorist Incidents

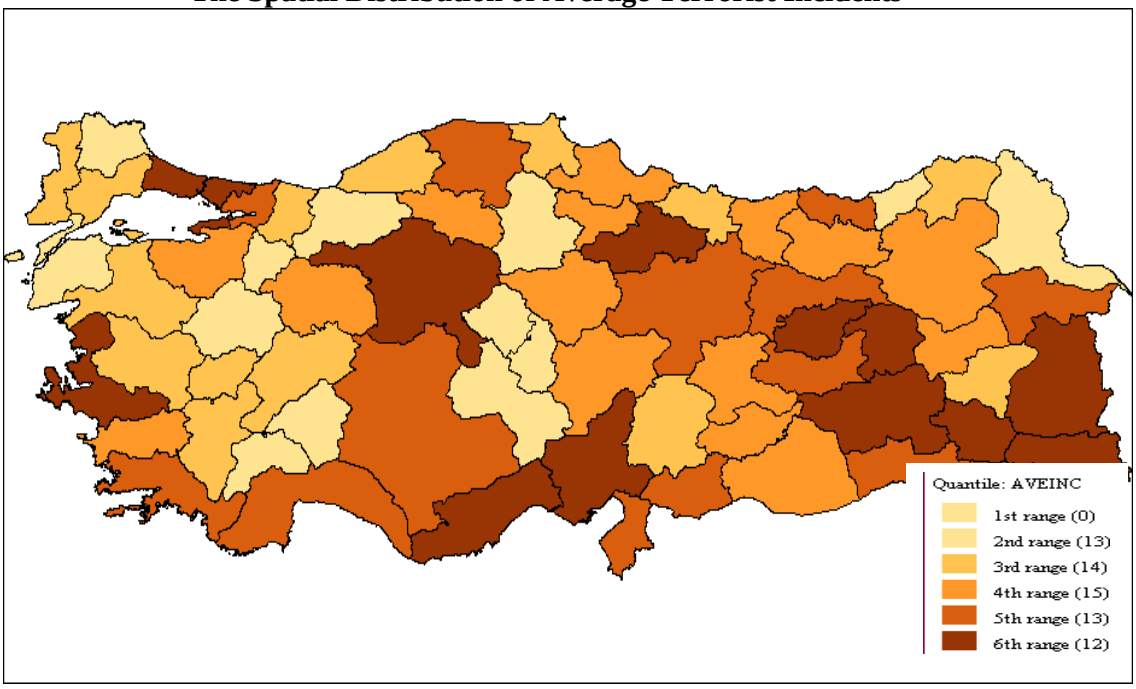


Figure 2
The Spatial Distribution of Average Injuries

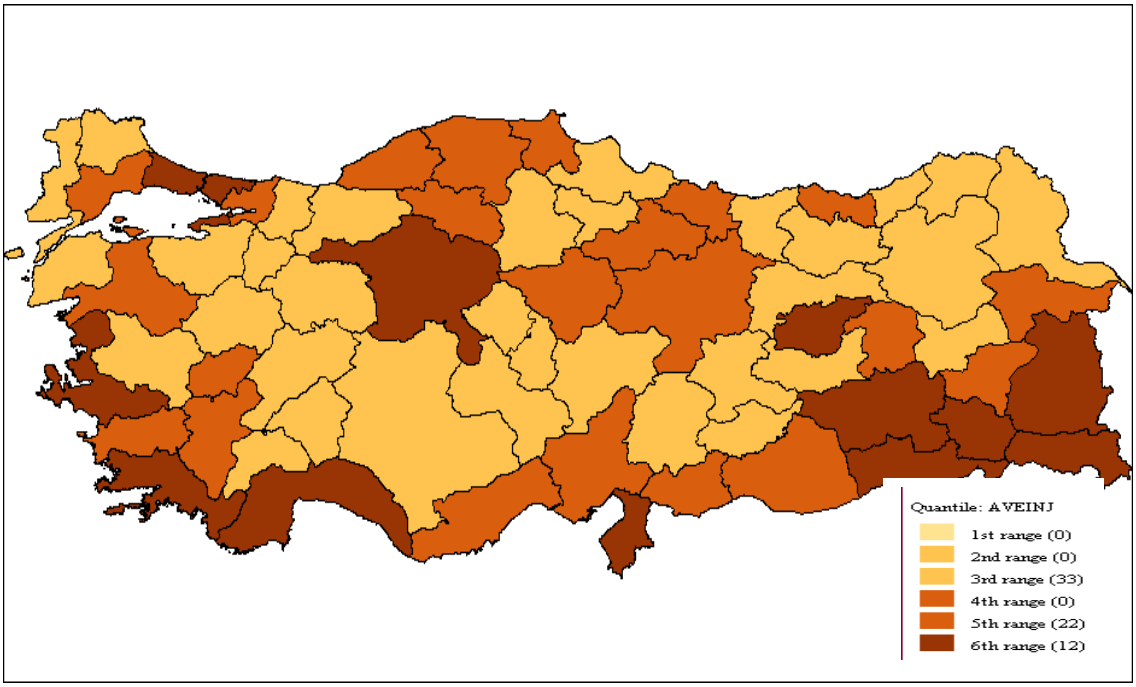


Figure 3
The Spatial Distribution of Average Fatalities

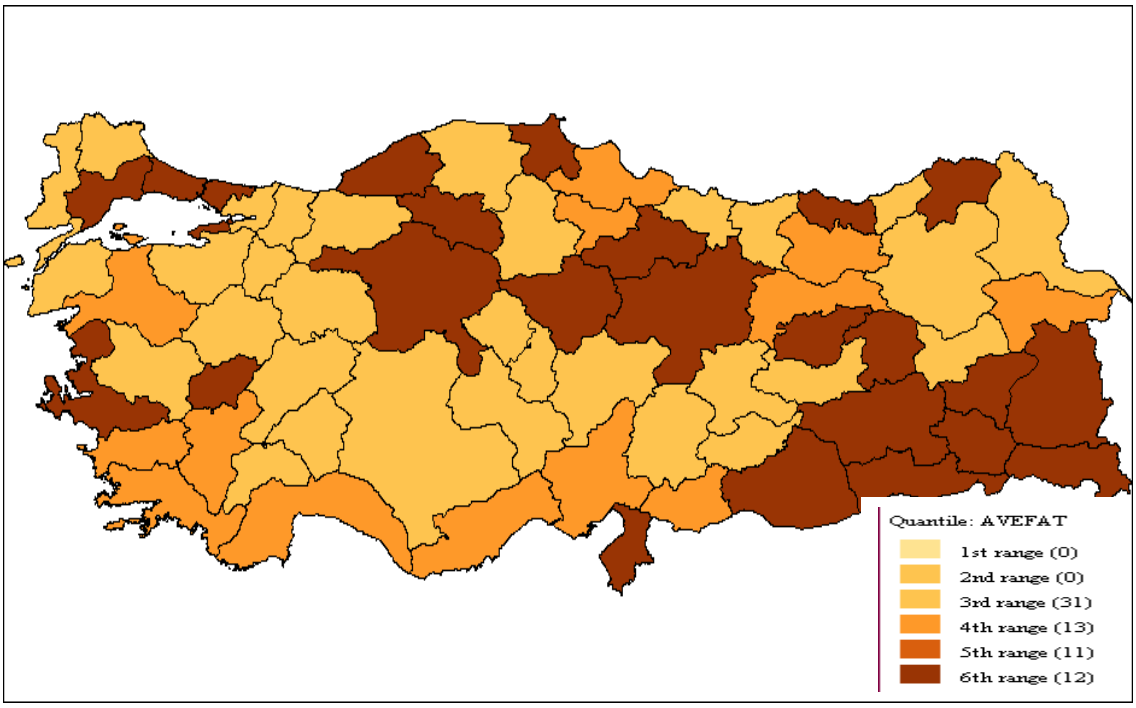


Figure 4
The Spatial Distribution of Terrorism Index

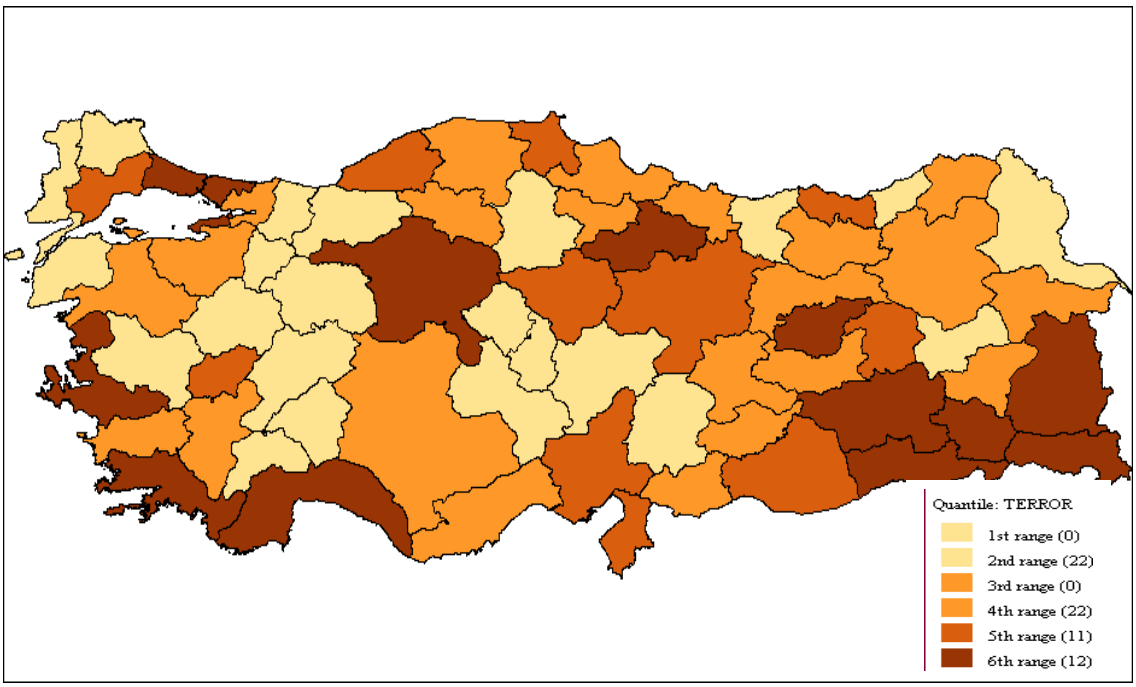


Table 1
Global and Local Parameter Estimates of the Model

Variables	Minimum	Lower Quartile	Median	OLS	Upper Quartile	Maximum
Constant				10.31**		
	9.758	10.046	10.334	(0.06)	10.681	10.968
Logy				-3.944**		
	-4.164	-4.074	-3.957	(0.02)	-3.846	-3.736
E				-0.331*		
	-0.337	-0.334	-0.332	(0.00)	-0.330	-0.327
LogU				2.355*		
	2.290	2.317	2.340	(0.00)	2.362	2.388
Coastal				2.247**		
	2.163	2.203	2.237	(0.02)	2.272	2.306
R^2			0.50	0.45		
AIC			360.51	363.86		
F Statistic				4.55*		
				(0.00)		

Note: The number of nearest neighbors in GWR model is 8 and the values in parantheses are the p-values. *, ** and *** denotes significance at 1, 5 and 10 per cent level, respectively.

Figure 5
Spatial Distribution of the Coefficient of average real per capita Income

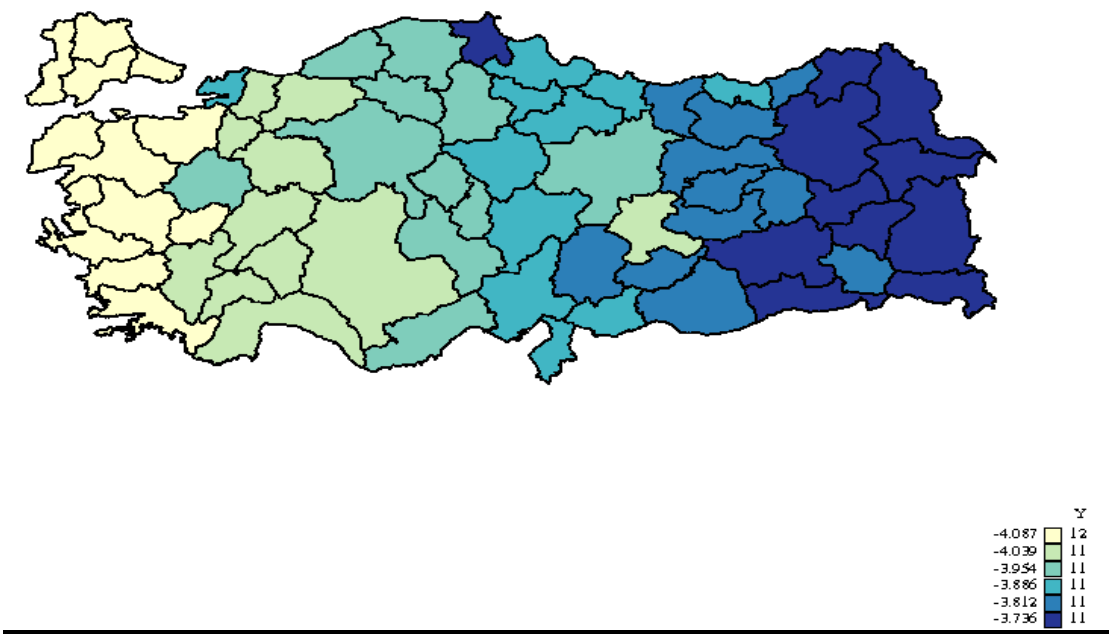


Figure 6
Spatial Distribution of the Coefficient of Average Education

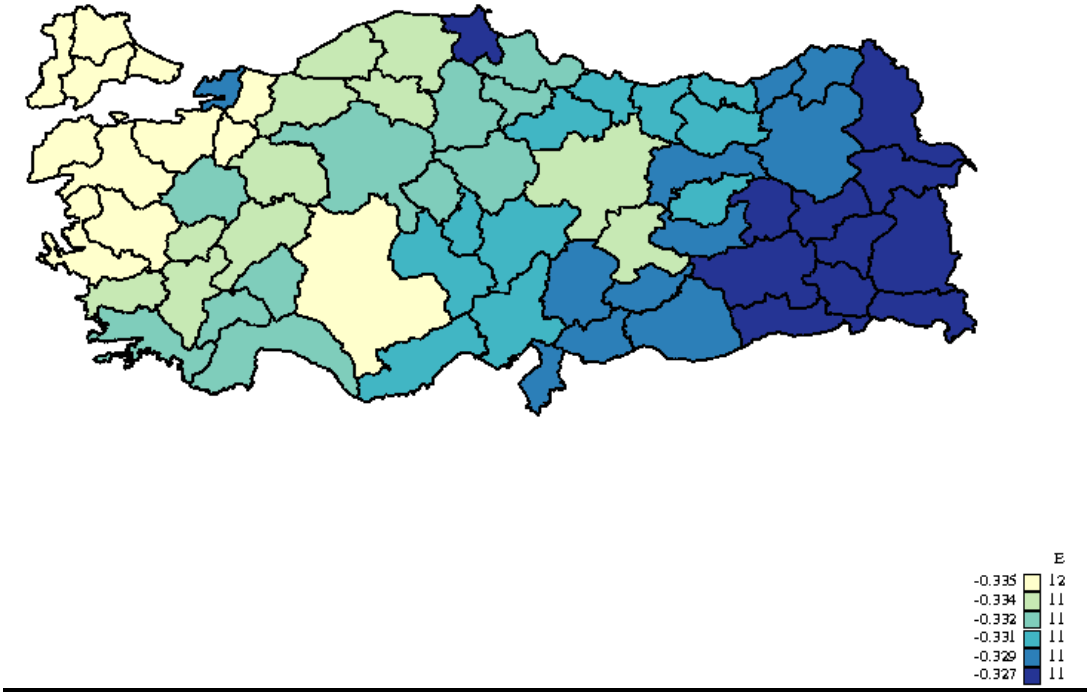
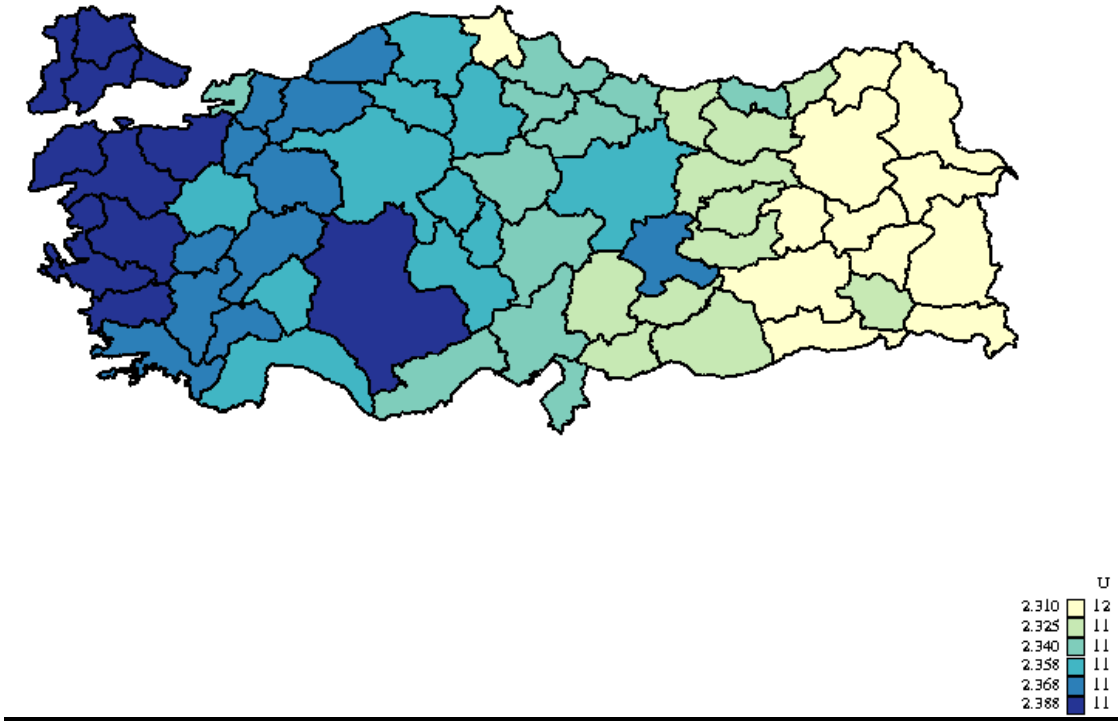


Figure 7
Spatial Distribution of the Coefficient of average Unemployment



References

Abadie, Alberto, 2004. Poverty, political freedom and the roots of terrorism. *NBER WP* 10859.

Abadie, Alberto and Javier Gardeazabal. 2003. The economic cost of conflict: A case study of the basque country. *American Economic Review* 93(1): 113-132.

Abadie, Alberto, and Javier Gardeazabal. 2008. Terrorism and the world economy. *European Economic Review* 52(1): 1–27.

Azam, Jean Paul, and Alexander Delacroix. 2006. Aid and the delegated fight against terrorism. *Review of Development Economics* 10(2), 330-344.

Azam, Jean Paul, and Véronique Thelen. 2008. The roles of foreign aid and education in the war on terror. *Public Choice* 135, 375-397.

Barros, Carlos P. and Isabel Proença. 2005. Mixed logit estimation of radical islamic terrorism in Europe and North America. *Journal of Conflict Resolution* 49(2): 298-314.

Berrebi, Claude. 2007. Evidence about the link between education, poverty and terrorism among palestinians. *Peace Economics, Peace Science and Public Policy* 13, 1, 2, http://www.bepress.com/peps/vol13/iss1/2.

Blomberg, Brock S., Gregory D. Hess, and Athanasios Orphanides. 2004a. The macroeconomic consequences of terrorism. *Journal of Monetary Economics* 51(5): 1007 1032.

Blomberg, Brock S., Gregory D. Hess, and Akila Weerapana. 2004b. Economic conditions and terrorism. *European Journal of Political Economy* 20(2): 463–478.

Blomberg, Brock S. and Gregory D. Hess. 2006. How much does violence tax trade? *Review of Economic and Statistics* 88(4): 599–612.

Blomberg, Brock S., and B. Peter Rosendorff. 2006. A gravity model of globalization, democracy and transnational terrorism. Research Paper C06-6, University of Southern California.

Blomberg, Brock S. and Gregory D. Hess. 2008a. The lexus and the olive branch: globalization, democratization and terrorism. In: Keefer, P., Loayza, N. (Eds.), *Terrorism, Economic Development, and Political Openness* Cambridge University Press: New York, pp. 116-147.

_____. 2008b. From (no) butter to guns? Understanding the economic role in transnational terrorism. In: Keefer, P., Loayza, N. (Eds.), *Terrorism, Economic Development, and Political Openness.* Cambridge University Press: New York, pp. 83-115.

Braithwaite, Alex, and Li., Quan 2007. Transnational terrorism hot spots: Identification and impact evaluation. *Conflict Management and Peace Science* 24(4), 281-296.

Bravo, A.B.S., and Dias, C.M. 2006. An empirical analysis of terrorism: Deprivation, islamism and geopolitical factors. *Defence and Peace Economics* 17(4), 329-341.

Brunsdon, Chris, A. Stewart Fotheringham, and Martin. E Charlton. 1998. Spatial nonstationarity and autoregressive Models. *Environment and Planning A,* 30: 957- 973.

Burgoon, B. 2006. On welfare and terror: Social welfare policies and political-economic roots of terrorism. *Journal of Conflict Resolution* 50(2), 176-203.

Caplan, Bryan. 2006. Terrorism: The relevance of the rational choice model. *Public Choice* 128, 91-107.

Drakos, Konstantinos, and Ali M. Kutan. 2003. Regional effects of terrorism on tourism in three mediterranean countries. *Journal of Conflict Resolution* 47(5): 621-641.

Eckstein, Zvi, and Daniel Tsiddon. 2004. Macroeconomic consequences of terror: Theory and the case of Israel. *Journal of Monetary Economics* 51(5): 971–1002.

Eldor, Rafi, and Rafi Melnick, 2004. Financial markets and terrorism. *European Journal of Political Economy* 20(2): 367-386.

Enders, Walter, Gerald F. Parise, and Todd Sandler. 1992. A Time-series analysis of transnational terrorism: Trends and cycles. *Defense Economics* 3(4): 305-320.

Enders, Walter, and Todd Sandler. 1993. The Effectiveness of antiterrorism policies: A vectorautoregression-intervention analysis. *American Political Science Review* 87(4): 829-844.

_____. 1996. Terrorism and foreign direct investment in Spain and Greece. *Kyklos* 49(3): 331-352.

_____. 1999. Transnational terrorism in the post–coldwar era. *International Studies Quarterly* 43(1): 145-167.

_____. 2000. Is Transnational terrorism becoming more threatening? A time-series investigation. *Journal of Conflict Resolution* 44(3): 307-332.

_____. 2006. *The political economy of terrorism*, New York: Cambridge University Press.

Feridun, Mete, and Selami Sezgin. 2008. Regional underdevelopment and terrorism: the case of south eastern Turkey. *Defence and Peace Economics* 19(3): 225 – 233.

Fielding, David. 2003. Counting the cost of the intifada: Consumption, saving and political instability in Israel. *Public Choice* 116(3-4): 297-312.

Fielding, David. 2004. How does violent conflict affect investment location decisions? Evidence from Israel during the Intifada. *Journal of Peace Research* 41(4): 465-484.

Fotheringham, A. Stewart, Martin E. Charlton, and Chris Brunsdon. 1997. Two techniques for exploring nonstationarity in Geographical Data. *Geographical Systems* 4: 59-82.

_____. 1998. Geographically weighted regression: A Natural evolution of the expansion method for spatial data analysis. *Environment and Planning* A 30 (11): 1905-1927.

Fotheringham, A. Stewart, Chris Brundson, and Martin E. Charlton. 2002. Geographically weighted regression: The analysis of spatially varying relationships. Chichester: Wiley.

Frey, Bruno S., Simon Luechinger, and Alois Stutzer. 2007. Calculating tragedy: Assessing the costs of terrorism. CESifo Working Paper No. 1341, the CESifo Group, Munich.

Freytag, Andreas., Jens J. Krüger, and Friedrich Schneider. 2008. The Origins of terrorism: Cross-country estimates on socio-economic determinants of terrorism. Paper presented at the 2nd NEAT Workshop, Brussels, 22th September 2008.

Gurr, Tedd. 1970. Why men rebel. Princeton University Press: Princeton.

Hall, C. Michael, and Vanessa O'Sullivan. 1996. Tourism, political instability and violence. in Abraham Pizam and Yoel Mansfeld, eds. *Tourism, Crime and International Security Issues* New York: John Wiley (105-121).

Krieger, Tim, and Daniel Meierrieks. 2008. What causes terrorism? Working Papers 12, University of Paderborn, CIE Center for International Economics.

Krueger, Alan B., and Jitka Malečková. 2003. Education, poverty and terrorism: Is there a causal connection? *Journal of Economic Perspectives* 17(4), 119-144.

Kurrild-Klitgaard, Peter, Mogens K. Justensen, and Robert Klemmensen. 2006. The Political economy of freedom, democracy and transnational terrorism. *Public Choice* 128, 289-315.

Lai, Brian. 2007. "Draining the Swamp": An Empirical examination of the production of international terrorism, 1968-1998. *Conflict Management and Peace Science* 24(4), 297-310.

Leung, Yee, Chang-Lin Mei, and Wen-Xiu Zhang, 2000. Statistical tests for spatial nonstationarity based on the geographically weighted regression model. *Environment and Planning A* 32: 9–32.

Li, Quan. 2005. Does Democracy Promote or Reduce Transnational terrorist incidents?. *Journal of Conflict Resolution*. 99, 278-297.

Li, Q., and Schaub, D. 2004. Economic globalization and transnational terrorism: A pooled time-series analysis. *Journal of Conflict Resolution* 48(2), 230-258.

Llussá, Fernande, and Jose Tavares. 2007. The economics of terrorism: A synopsis. *The Economics of Peace and Security Journal* 2 (1): 61-70.

Loğoglu, Faruk. 2008. Terrorism: Turkey at the crossroad. *Today' Zaman* 03.03.2008. http://www.todayszaman.com/tz-web/detaylar.do?load=detay&link=135353.

Neumayer, Eric. 2004. The impact of political violence on tourism: Dynamic cross national estimation. *Journal of Conflict Resolution* 48(2): 259-281.

Nitsch, Volker, and Dieter Schumacher. 2004. Terrorism and international trade: An empirical investigation. *European Journal of Political Economy* 20(2): 423–433.

Ocal, Nadir and Julide Yildirim. 2010. Regional effects of terrorism on economic growth in Turkey: A geographically weighted regression approach. *Journal of Peace Research* forthcoming.

Piazza, James A. 2006. Rooted in Poverty?: Terrorism, poor economic development, and social cleavages. *Terrorism and Political Violence* 18, 1, 159-177.

_____. 2008. Incubators of terror: Do failed and failing states promote transnational terrorism. *International Studies Quarterly* 52, 469-488.

Plümper, Thomas, and Eric Neumayer. 2007. The friend of my enemy is my enemy. *International Alliances and International Terrorism* Mimeo, University of Essex and London School of Economics.

Rodoplu, Ulkumen, Jeffrey Arnold, and Gurkan Ersoy. 2003. Terrorism in Turkey: implications for emergency management. *Prehosp Disast Med* 18(2): 152–160.

Sandler, Todd, and Walter Enders. 2004. An economic perspective on transnational terrorism. *European Journal of Political Economy* 20, 301-316.

Temple, Jonathan. 1999. The new growth evidence. *Journal of Economic Literature* 37(1): 112- 156.

Yechiam, Eldad, Greg Barron, and Ido Ere. 2005. The role of personal experience in contributing to different patterns of response to rare terrorist attacks. *Journal of Conflict Resolution* 49(3): 430–39.

Yildirim, Julide, Nadir Ocal, and Suheyla Ozyıldırım. 2009. Income inequality and economic growth in Turkey: A spatial effect analysis. *International Regional Science Review* 32: 221-254.